Using GIS to Create and Analyze Potentiometric-Surface Maps

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INTRODUCTION

This paper describes the content of a poster display that is directly related to the oral presentation and paper of Jones and Barrett (this volume). Jones and Barrett discussed at length the GIS used to construct this poster as well as the database used to create the GIS layers. [GIS applications were based on Environmental Systems Research Institute (ESRI) software, including Arc Map, Arc Catalog, Arc Toolbox (Spatial Analyst, 3-D Analyst) and Arc Workstation (9.1).] Here, we will reintroduce their discussion and add some further explanation and details regarding the poster itself.

DISCUSSION OF THE POSTER

The poster (Figure 1) is available for download at http://ngmdb.usgs.gov/Info/dmt/docs/angle06.pdf, and contains a legend with a brief explanation and three panels. Each of the three panels depicts an identical base map of the study area overlain by various layers created by the process described in Jones and Barrett (this volume). The study area is a section of Darby Creek in western Franklin County, Ohio. A National and State Scenic River, Darby Creek provides an area of unique habitat to many endangered species of mussels and minnows. It is also an area that is undergoing rapid development pressure. Numerous parties, including planners, geologists, surface water ecologists, and fish biologists, were interested in determining the full impact of ground water flow on Darby Creek and a major tributary, Hellbranch Creek. There was particular interest in determining the gradient of the water table for the bedrock and unconsolidated (sand and gravel) aquifers, which are possible areas of ground water discharge to Darby Creek and Hellbranch Creek. Areas of recharge to the aquifers were of importance as well. It should be noted that part of the purpose was to create maps that would be easily understood by those with little geologic background.

The panel on the left shows the bedrock aquifer potentiometric-surface contours (arcs) superimposed over a topographic DRG basemap. This map helped portray the elevation, rough gradient, and direction of flow of the potentiometric-surface of the bedrock (limestone) aquifers.

The center panel shows the sand and gravel aquifer potentiometric- surface contours (arcs) superimposed over the same topographic DRG basemap. This map helped display the elevation, gradient, and direction of flow of the potentiometric-surface of the sand and gravel aquifers.

In most of the study area, the sand and gravel aquifer overlies the bedrock aquifer. There was an even distribution of water well log data points over the area that derived water either from the limestone aquifer or the sand and gravel aquifer. There was interest in the relative contribution of each aquifer to streamflow, and in the recharge areas of the aquifers.

The right panel shows a difference map that was used to compare potentiometric-surface maps. For each map, the shapefile was converted into a TIN model, which was then converted into a grid. Arc Map's Spatial Analyst was used to perform a subtraction between the two grids. A ras-

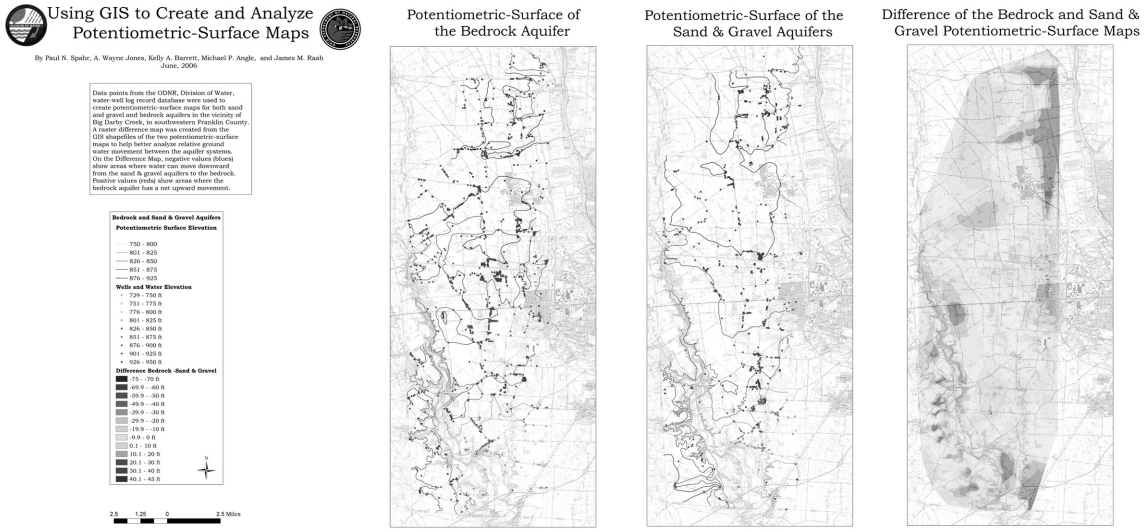

Figure 1. Poster “Using GIS to create and analyze potentiometric - surface maps”.

ter difference map was then generated; this showed a value for the potentiometric head that indicates whether there was a relative movement of ground water from the sand and gravel aquifer into the bedrock aquifer or vice versa.

On the difference map, negative values (blues) show areas where water has a net downward movement from the sand and gravel aquifers to the bedrock aquifers. The blue areas are found on the uplands between Darby Creek and Hellbranch Creek. These areas tend to be recharge areas for both aquifers. Positive values (reds) show areas where the bedrock aquifer has a net upward effect, so water moves from the bedrock into sand and gravel units. These areas tend to be along the steep valley sides of Darby Creek and, commonly, are where the aquifers discharge. These small, steep tributaries of Darby Creek provide baseflow to the stream.

The information in this poster was widely accepted by the planners, biologists, and other stakeholders interested in the project. Readers are encouraged to view the poster in color at http://ngmdb.usgs.gov/Info/dmt/docs/angle06.pdf.

REFERENCE

Building a Water Well Database for GIS Analysis, by A. Wayne Jones and Kelly A. Barrett (Ohio Department of Natural Resources, Division of Water) DMT 2006, The Ohio State University, 125 South Oval Dr., Columbus, Ohio 43210. http://ngmdb.usgs.gov/Info/dmt/docs/jones06.ppt.